

Lessons Learned: Development and Testing of A Multi-Agency, Multi-Function Water Operations Model In A Fish Bowl

Don Gallegos¹, Mark Yuska², Marc Sidlow³

¹ U.S. Army Corps of Engineers, Albuquerque District, Reservoir Control Branch,
4101 Jefferson Plaza, NE, Albuquerque, NM 87109,
PH (505) 342-3382; Fax (505) 343-3289 e-mail: donald.j.gallegos@usace.army.mil;

² PH (505) 342-3608; e-mail: mark.e.yuska@usace.army.mil;

³ PH (505) 342-3381, e-mail: marc.s.sidlow@usace.army.mil

Abstract

More than a few lessons have been learned in the development and testing of the Upper Rio Grande Water Operations Model (URGWOM). URGWOM is a set of daily time-step, river-reservoir models for the Upper Rio Grande basin utilizing a numerical computer modeling software (RiverWare). URGWOM was developed with the recognition that success is dependent on the confidence that the stakeholders have in the set of models. Each step of the technical development, review, testing, and documentation has been conscientiously undertaken with that precept in mind; as well as, to meet the objectives of the development agencies. This presentation demonstrates some technical problems and challenges that are being addressed to build stakeholder confidence. Specifically, these are related to: functions of the model, model development input data, technical review, accounting rules development, data sharing, model and data quality, and documentation.

Introduction

The study area referred to in this summary of lessons learned is part of the upper Rio Grande basin (Figure 1) from the Closed Basin in southwestern Colorado to Fort Quitman, Texas. The upper Rio Grande basin is both physically and institutionally complex. It includes an extremely variable water supply, trans-basin and native basin water, increasing population, competing water needs, endangered species, interstate compact among three states, international treaty with Mexico, 19 Native American Pueblos, and ongoing litigation in the basin.

The primary purpose of the Upper Rio Grande Water Operations Model (URGWOM)(USACE, *et al*, 1997) <http://www.spa.usace.army.mil/urgwom> is to facilitate more efficient and effective management of water in the basin. Although management decisions have become increasingly more complex and difficult since the inception of the model in late 1995, URGWOM has kept pace with management needs. It currently is being used to integrate Rio Grande federal river and reservoir operations and aid in the recovery of endangered species in the middle Rio Grande. Current boundary limits of the model extend from the Colorado/ New Mexico State Line to El Paso, Texas.



Figure 1. Location Map of Upper Rio Grande Basin

A contributor to the ultimate success of this endeavor, but potentially a complicating factor, is the necessity of developing the model in a very open process. The scope of the discussions with basin interests in the early coordination meetings ranged from full support to suspicion. Development of URGWOM, “in a fish bowl”, reliant upon the constructive participation of interested and affected parties, and continually focused on communications and coordination was critical to developing stakeholder confidence in URGWOM as a useful, neutral tool for the basin.

The following discussion covers the issues that are particularly important in building confidence in our project, and may be of interest to others who are developing or using similar tools in difficult arenas.

Functions of the Model

In its conceptual state, URGWOM was different things to different people, and, perhaps, everything to some. Although this list is not all inclusive, the stakeholders wanted it to:

- Aid in making the federal water management agencies understand how their actions affect others,
- Realistically simulate the physical processes and institutional complexities of the surface water system, including wet and drought periods,
- Aid in sharing data,
- Ensure no assumptions or data are hidden, and
- Be flexible enough to adjust to changing institutional rules, or physical conditions.

Oddly enough, or not so oddly, these wants were not very different from the development agencies needs for the tool. These needs were kept in mind through open Technical Review Committee meetings, through software selection, a test case on the Rio Chama, and development into four functioning models:

- A forecasting model that uses historical hydrographs with snowmelt forecasts,
- An accounting model that separately tracks Rio Grande water, transbasin water, and about two dozen contracts for the transbasin water,
- A daily operations model that utilizes information from the other two models, and simulates the river and reservoir physical system for the short term, and
- A planning model in which effects of long-term operational changes can be evaluated.

All but the forecast model utilize the physical model, data, routing techniques, methods, loss coefficients, and leakage estimates.

Model and Data Quality

The six federal cooperating agencies documented and developed the URGWOM Quality Control Plan and the Database and Model Testing Quality Assurance/Quality Control (QA/QC) Plan (USACE, *et al* 2001/2002). Although quality control and technical review procedures of technical team products had already begun as early as 1996, documenting and expanding these procedures in 2001-2002 were necessary for eventual acceptance and use of the models. Peer review and Technical Review Committee review resulted in memoranda summarizing the comments and responses to ensure that the document or models were properly modified or clarified to address comments. Database and model testing methods were incorporated into the public record on the URGWOM website for inspection. Further testing by the cooperating agencies and others outside of the development process will be conducted according to the QA/QC Plan to ensure that the models are meeting their intent.

Documentation.

URGWOM is intended to be developed and operated with accuracy sufficient to represent all significant influences. An important aspect of the documentation process is disclosure of the current limitations of the models. Lack of adequate physical data or poor data in many areas precludes the precise, reliable simulation of many physical features operating in the basin. In these cases, URGWOM uses the best available data, which in some cases is the only available data, to simulate physical processes. In keeping with the originally expressed needs of the stakeholders, documentation, including disclosure of all of its limitations, has occurred in lockstep with model development. It has been as important to keep telling the interested parties what URGWOM is not, as well as, what it is.

All the current documentation are considered “working” documents, updated further as model changes and additional data become available. Just like in making soup by adding ingredients to water and continued cooking, it has been left up to the users to determine the degree of development doneness of these modeling tools. A positive benefit of this process has been that URGWOM has been useful in identifying areas where additional data or investigations are needed.

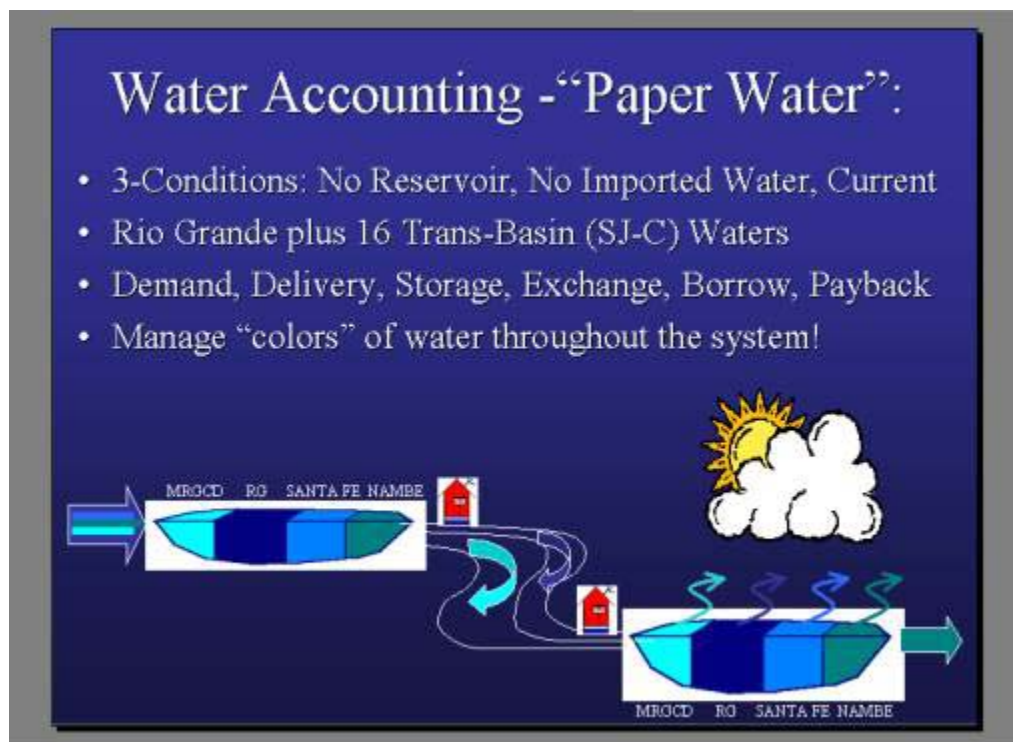


Figure 2. Water Accounting – A Major Source of Modeling Complexity

Model Development Input Data.

A large share of input data collected from partners and stakeholders of URGWOM were made available to the general public on the web. Some of the data used in the development of URGWOM were modified from the data sets supplied by the originating agency. Disclosure of these modifications was made right up front in the public release of the model development data. The range of potential modifications were described and the viewer was urged to contact the originating agency for unchanged data. Both model input data and supporting data that were used in the calibration and verification process were furnished on the public web site with metadata files which explain the source and any modification of the data. Metadata files also include data organization by site, river reach, and subject category. This was a first giant step in sharing data and making the model accessible to all interested parties. This process will continue, as URGWOM is refined.

Technical Review.

The Technical Review Committee is made up of representatives or observers from agencies or entities that have an interest in URGWOM development. Participation is open and voluntary and provides all parties the opportunity to review each development phase of the models. They have been on the job since 1996, ensuring that no assumptions or data are hidden and that the modeling development continues to strive for realistic representation of the Rio Grande system. URGWOM Steering Committee meetings are also open. Both meeting notes are posted on the website. Our mutual concerns, problems and frustrations, as well as our successes and solutions end up in the notes for all to see (warts and all). The benefit has been better products at each juncture.

Accounting Rules Development

The rule that “nothing is ever easy or simple” applies most aptly to URGWOM accounting rules development. Rio Grande Compact accounting and contractor accounting for transbasin water depend on the accurate representation by these rules in URGWOM. While these are probably the most susceptible to suspicion by the stakeholders, they have been the slowest and most complex to document and de-bug. In-house testing has involved using real problems such as developing 2002, 2003 Annual Operating Plans and development of “what if” management scenarios to address endangered species and other issues. The Planning model which uses a 40-year sequence is currently being used to further test that the rules work for most circumstances over wet, dry, and in between conditions. Although draft rules documentation is available on the URGWOM website, until most of the bugs have been worked out, complete and comprehensive descriptions and a decision tree of the rules is delayed until the Planning model runs are trouble free.

Data Sharing

Beyond making model development data available, an eventual goal of URGWOM is to provide easier access to the URGWOM hydrologic and operations input and output data. Development of this hydrologic database for the upper Rio Grande is in the works, as well as, providing links to other data collection entities within the basin. The intent here, again, is to share information to inform stakeholders and to build confidence in the tools that utilize the information. URGWOM as a communication tool to make daily water operations data available on the web site is within reach. It is critically important to do this soon as possible so that others besides the development agencies understand the utility of the model and use the best available data for decision making.

Conclusion

The development agencies have kept URGWOM models development process as open and transparent as possible. It has contributed to communication and coordination among many entities and to more data sharing, as well. Development in this open process has encouraged and fostered dialogue and ideas for further refinements and cooperation. A good many of the issues discussed above are ongoing, just as we hope that participation and confidence of the stakeholders are ongoing.

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